
Contents

	Preface	ix
Chapter 1	Overdispersion	1
	1.1 A Simple Introductory Example.....	1
	1.2 Overdispersion	3
	1.3 A Common Characterization of Overdispersion	4
	1.4 An Extended Definition of Overdispersion.....	6
	1.5 A Simulated Example.....	7
	1.6 The Exponential Family	11
	Appendix 1.1: Hierarchical Models to be Covered in this Book	14
Chapter 2	Generalized Linear Models	15
	2.1 Introduction	15
	2.2 Linear Regression Models	16
	2.3 A Simple Linear Regression Example	19
	2.4 Generalized Linear Models	22
	2.5 The Deviance and the Pearson Chi-Square Statistic	24
	2.6 Maximum Likelihood Estimation for Generalized Linear Models.....	26
	2.7 A Dosage-Mortality Example.....	28
	2.8 Odds-ratios and Logistic Regression.....	39
	2.9 A Poisson Example of Failures of Electronic Equipment.....	46
Chapter 3	Quasi-likelihood Functions	51
	3.1 Introduction	51
	3.2 Quasi-likelihood functions	52
	3.3 An Oral Care Example	54
	3.4 Toxoplasmosis in El Salvador	57
	3.5 A Carcinogenesis Pre-clinical Experiment	63
	3.6 An Osteoporotic Example of Patients at High Risk for Vertebral Fractures.....	66
	3.7 Williams' Quasi-likelihood Model.....	69

Chapter 4	Likelihood Models for Overdispersed Binomial Responses	77
4.1	Introduction	77
4.2	The Beta-binomial Distribution	78
4.3	The Random-clumped Binomial Distribution	80
4.4	A Zero-inflated Binomial Distribution	83
4.5	A Generalization of the Binomial Distribution	84
4.6	An Example with Secondary Association of Chromosomes ..	86
4.7	Further Characterization of the Beta-binomial and Random-clumped Binomial Distributions.....	94
4.8	Generalized Linear Overdispersion Models for Binomial Responses	101
4.9	A Teratology Example about Ossification on the Phalanges	103
4.10	Generating Data under the Beta-binomial and Random-clumped Binomial Distributions.....	112
Chapter 5	Goodness-of-fit Tests for Overdispersed Binomial Models	115
5.1	Introduction	115
5.2	Testing “No Overdispersion” against an Overdispersed Binomial Alternative	116
5.3	An Omnibus Goodness-of-fit Test	121
5.4	Extension of the GOF Test When Covariates Are Present: The Hiroshima Chromosome Aberration Example	130
	Appendix 5.1: Module “GOF_BB”	138
	Appendix 5.2: Module “GOF_RCB”	146
	Appendix 5.3: GOF Test under Both the Beta-binomial and Random-clumped Binomial Distributions When Covariates Are Present.....	154
Chapter 6	Likelihood Models for Overdispersed Count Responses	159
6.1	Introduction	159
6.2	The Negative-binomial Distribution	160
6.3	The Zero-inflated Poisson and Zero-inflated Negative-binomial Distributions	164
6.4	Example of Number of Eggs of the Intestinal Trematode <i>Schistosoma Mansoni</i>	167
6.5	Generalized Linear Overdispersed Models for Count Responses	174
6.6	An Example of Urinary Tract Infections (UTI) in Men Infected with HIV.....	175
6.7	Hurdle Models	183

Appendix 6.1: Generation of Data under the Negative-binomial Distribution.....	195
Appendix 6.2: Generation of Data under the Poisson Hurdle and Negative-binomial Hurdle Models.....	197
Chapter 7 Likelihood Models for Overdispersed Multinomial Responses	201
7.1 Introduction	201
7.2 The Multinomial Distribution	202
7.3 Link Functions and Maximum Likelihood Estimation.....	203
7.4 An Example of a Generalized Logits Model.....	206
7.5 Quasi-likelihood Models	212
7.6 A Birth Defects Study	214
7.7 The Dirichlet-multinomial Distribution	223
7.8 The Random-clumped Multinomial Distribution	225
7.9 A Study on Housing Satisfaction	226
7.10 A Forest Pollen Count Problem.....	228
7.11 Generalized Linear Overdispersed Models for Multinomial Responses—the Birth Defects Study Revisited.....	231
7.12 Modeling the Coefficient of Agreement Kappa via the Dirichlet-multinomial and the Random-clumped Multinomial Distributions.....	240
Appendix 7.1: Data Generation under the Dirichlet-multinomial and Random-clumped Multinomial Distributions .	246
Appendix 7.2: Module “DirMult_RCMult”	249
Chapter 8 A Two-stage Maximum Likelihood Estimation Procedure	261
8.1 Introduction	261
8.2 A Two-stage Estimation Procedure.....	262
8.4 The Forest Pollen Count Example Revisited	265
8.5 The Housing Satisfaction Example Revisited.....	267
Appendix 8.1: Simulation Results.....	269
Appendix 8.2: Macro “DM_RCM_Exact_Approximate”	272
Chapter 9 Generalized Estimating Equations Techniques for Marginal Models	283
9.1 Introduction	283
9.2 Marginal and Conditional Models.....	285
9.3 The GEE Methodology for Binary and Count Data	290
9.4 Estimation Methods.....	291
9.5 An Example with Binomial/Binary Responses	297

9.6	An Example on Seizure Counts for Epileptics	301
9.7	Ratio Estimation through Poisson Regression and GEE	306
9.8	The GEE Methodology for Multinomial Responses	317
9.9	A Shoulder Pain Study Example.....	319
9.10	Small Sample Bias Corrections for Sandwich Estimators	324
9.11	Testing for Homogeneity	328
 Chapter 10 Generalized Linear Overdispersion		
	Mixed Models.....	337
10.1	Generalities and Fundamental Concepts of GLMMs.....	337
10.2	A Multicenter Randomized Clinical Trial	345
10.3	Pump Reliability at a Pressurized Water Reactor Nuclear Power Plant	347
10.4	Example Multinomial Model with Random Effects	352
10.5	Beta-binomial and Random-clumped Binomial GLOMMs	356
10.6	Zero-inflated Poisson and Zero-inflated Negative- binomial GLOMMs	365
10.7	Concluding Remarks	373
 End of Journey.....		375
 List of Abbreviations		377
 References.....		379
 Index.....		387